2 Sheets--Sheet 1

G. E. SELLERS.

Improvement in Evaporating Salt Water.

No. 125,697. Patented April 16, 1872.

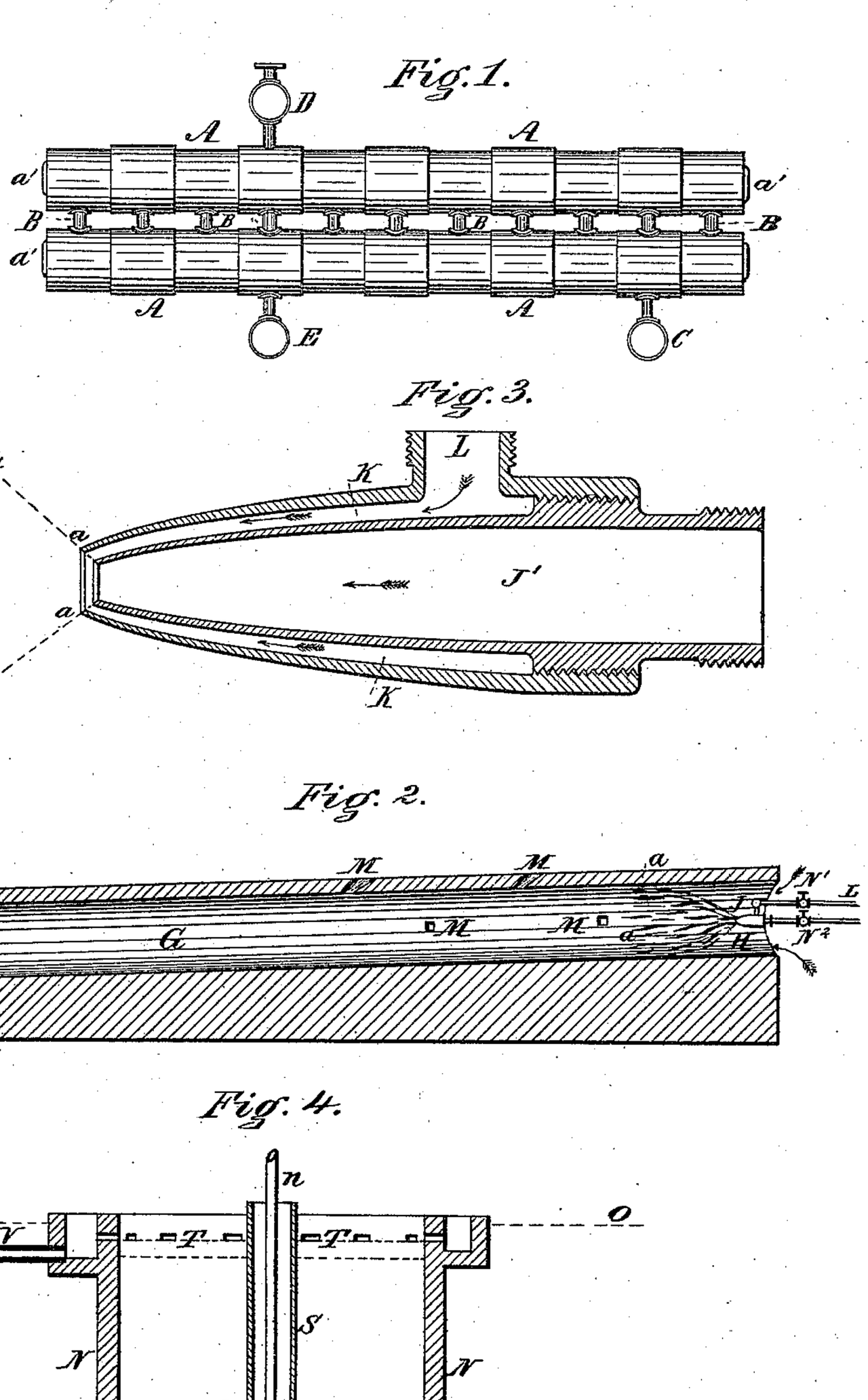
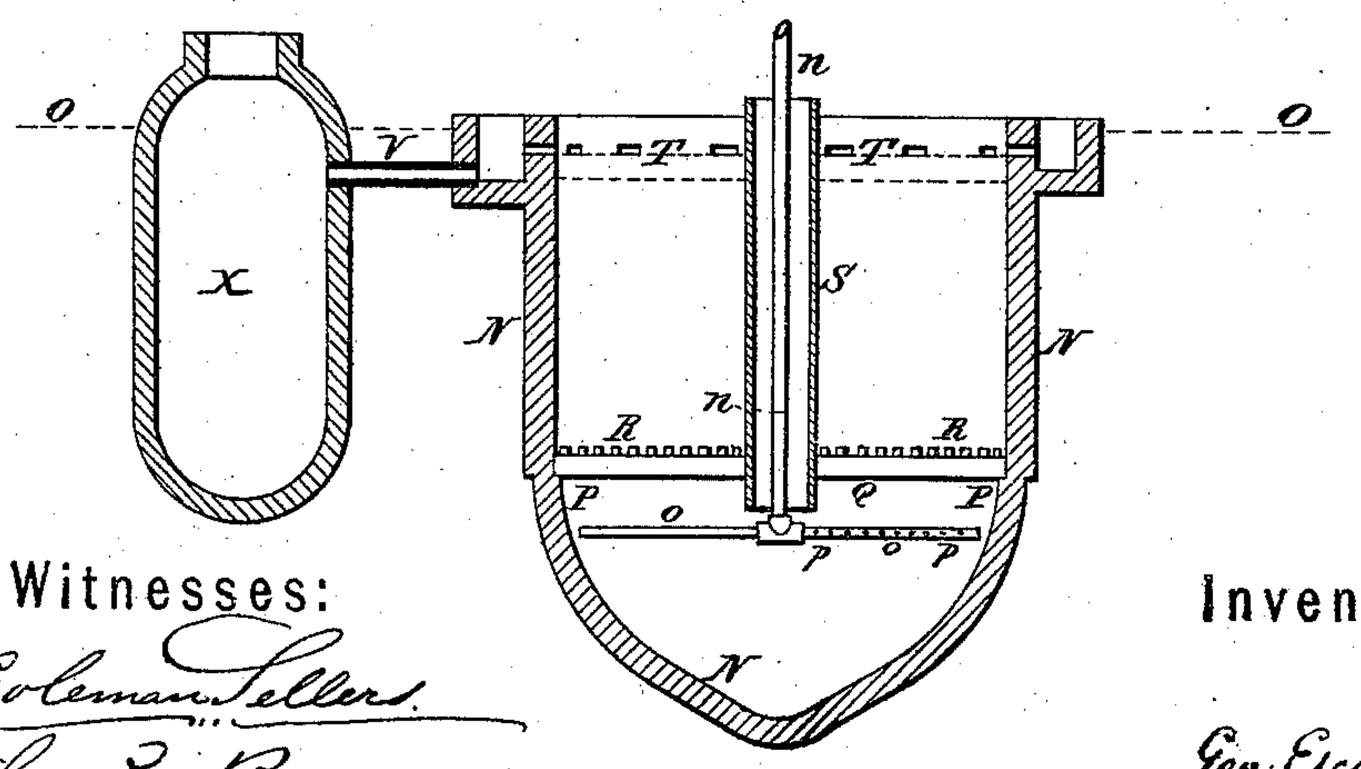


Fig. 1.

Fig. 3.

Fig. 2.

Fig. 4.



Witnesses:

Coleman Sellers.

Theodore Bergner.

Inventor:

Geo. Escol Sellers.

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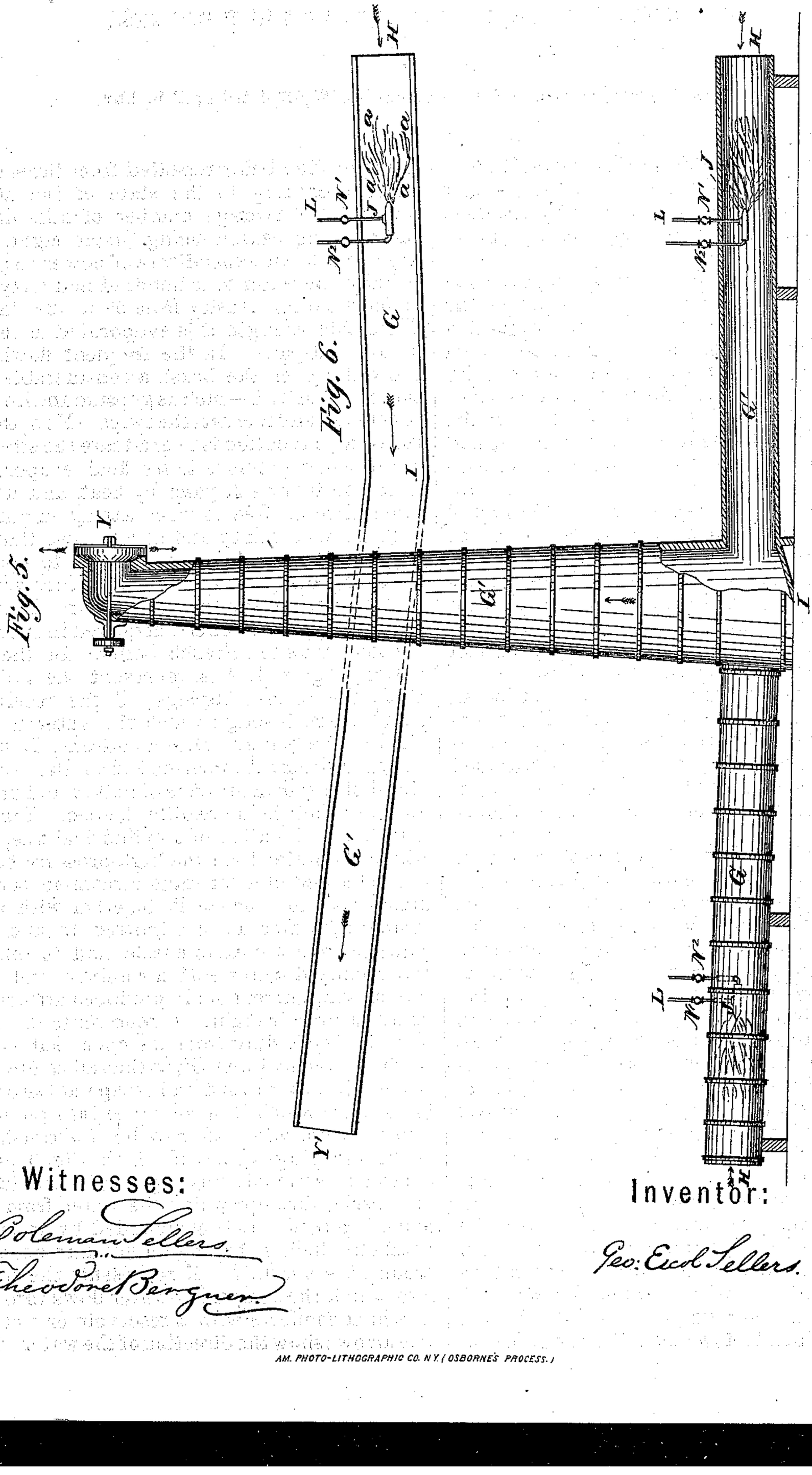

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125,697

UNITED STATES PATENT OFFICE.

GEORGE ESCOL SELLERS, OF BOWLESVILLE, ILLINOIS.

IMPROVEMENT IN EVAPORATING SALT BRINES.

Specification forming part of Letters Patent No. 125,697, dated April 16, 1872.

Specification describing an Improved Mode of Evaporating Salt-Water or Brine, and freeing it from earthy impurities, invented by GEORGE ESCOL SELLERS, of Bowlesville, county of Gallatin and State of Illinois.

The nature of the first part of my invention consists in first using all or a portion of the salt-water to be evaporated for the production of salt (chloride of sodium) to generate steam therefrom in high-pressure boilers for supplying the power required for various uses about salt-works—viz., to pump the water from the wells; to feed the boilers under pressure, and to drive the machinery appertaining to the manufacture of barrels, &c. I further maintain and utilize this boiler-pressure to thoroughly atomize the water as it is suffered to escape from the boiler. This spray of salt-water I confine within an arrangement of flues wherein currents of air are caused to mingle with the atomized water to condense the same, and to carry off as much moisture as the air can be loaded with without a waste of salt.

Another feature of my invention consists in an improved arrangement of settling and concreting cisterns to free the concentrated salt-water of much of the impurities contained therein as it is pumped from the wells, previous to its final evaporation in the ordinary salt-pans.

It is a well-established fact that sea-water or weak brines—say, below 5° of Baumé—cannot be profitably evaporated by fuel alone, and various devices have been resorted to to increase the density, such as natural evaporation in reservoirs, exposing great surface to the direct action of the sun and air, or by flowing the water over the surface of thorn-brush in lofty structures known as graduation houses, which have long been extensively used in Germany and France, and are now in use at Equality in this State. All the plans of natural evaporation by the exposure of large surface depend on the state of the weather, the degrees of temperature, and moisture of the air, and experience has shown that they cannot, under the most favorable circumstances, be resorted to with advantage during more than two-thirds of the year. At Durrenberg, in Germany, and Moutiers, in France, the water is pumped to an average elevation of fifty-five feet, from which it flows over the thorn-brush, the operation being repeated from three to ten times, according to the state of the atmosphere. The average number of falls during the working season being about eight, they are equal to an expenditure of power required to raise the water four hundred and forty feet, to increase its density from 5° to 18° Baumé. From this strength it is evaporated in the ordinary salt-pans. In the frequent flowing of the water over the brush a considerable portion of impurities—such as gypsum and iron—is concreted, and incrusts the twigs. Now, the object of my invention is to graduate the strength of the water previous to its final evaporation in the ordinary salt-pans by heat, and at the same time to free it from earthy impurities with more certainty and at less cost than by any process heretofore used, and to operate advantageously throughout the entire year.

To generate the steam-pressure, I prefer common cylinder-boilers, arranged in the manner known as the French boiler. In the elevation, Figure 1, A A represent the boilers; B B, the connecting-legs; C, the receiving-stand drum, through which the water is supplied to the boilers; D, steam-drum; E, blow-off-stand drum; F, furnace-end of the boilers. Man-holes *a' a'* in the ends of boilers and drums admit of their being readily cleaned. Fig. 2 is a sectional elevation of a cylindrical flue, into which the water from the high-pressure boiler is discharged in a constant stream in such a manner as to atomize it, together with such tempering water as is admitted to and discharged from the same nozzle, and to mingle the atomized water with a confined and rapidly-moving current of air, produced artificially or by natural draught. G represents the flue, slightly descending from its open end H toward the vertical flue G′, so that all condensed water will flow toward and escape at the opening I, from which it is conveyed into the purifying-cistern, hereinafter to be described. J is the escaping-nozzle, of which Fig. 3 is an enlarged sectional drawing. J′ is the internal nozzle, through which the water from the boiler is forced. It is surrounded by an outer nozzle or shell, J, having an annular opening around the nozzle J. K represents the space into which the tempering-water flows through L, which connects with a reservoir or cistern. The arrows show the direction of the water. The

action of this escape-nozzle differs from that of the Giffard injector, or the siphon steam-pump, inasmuch as with them the steam escapes through the inner nozzle, and, as it draws in and ejects the water, it is condensed and lessened in bulk; whereas, when highly-heated water, under pressure, escapes through this nozzle, the moment it passes from confinement it flashes into steam; so that if the outer shell or nozzle were projected beyond the inner one until the escape-orifice of each became the same size, the expansion of the water at the moment it passed the outlet of the inner nozzle would force the water back through the chamber K and connection L into the cistern, where the steam would be condensed or escape. The dotted lines *a a*, Figs. 2 and 3, show an approximation to the expanding column of water as it escapes through J′. This, in passing the annular opening of K, draws the water from the cistern, which, by the violence of the escaping water from the boiler, is atomized with it, forming a brush the full size of the flue G, which causes a strong current of air to rush in at the open end H. This current is increased by the heated column in the vertical flue G′. All the water that has flashed into steam is condensed by the air, which, in its place, becomes so intimately mingled and atomized with water that it becomes loaded with moisture, which escapes with it at the top of the flue G′. N^2 is a valve to regulate the water blown from the boiler, and N^1 a similar one to regulate the amount of tempering-water. As the flues become heated and the current in G′ established, more air can be loaded with moisture than passes in at H. I therefore make a series of openings into the flue, as shown at M M. These openings must be provided with doors or valves, so as to be opened or closed at the will of the operator. If they were open at the commencement of work, before the flues became heated, air and steam would rush out at them; but after the flues are once heated they can be gradually opened, and finally a large volume of air will rush in through them.

Fig. 4 is a sectional elevation of a circular cistern, N, sunk in the earth, brick-lined and cemented. O O is the level of the ground. P P, an offset in the brick lining to receive the floor of joist Q, on which rests a rack, R. S is a box or pipe passing from above the top of the cistern through its rack-floor R. Through this pipe S the water, as it runs from the opening I in the flue G, Fig. 2, is delivered into the cistern below the floor. The entire space above the rack-floor, between the pipe S and the outer walls of N, is filled with thorn-brush and coarse straw, through which the water rises to flow off through the openings T T into a trough surrounding the cistern, from which the brine is conveyed through the pipe V into the cistern X. From this cistern it is pumped into the ordinary salt-evaporating pans, and the crystallization completed in the usual way. The pipe S may be sufficiently large to admit a pump or steam-siphon to pump out the "sludge" that settles into the concaved bottom of the cistern, or a separate outlet and pipe may be provided for this purpose.

Experience has taught that gypsum and other impurities held in solution or mechanically suspended in the water, either separate and settle or concrete best when the water is at a high temperature. Under 120° very unsatisfactory results are obtained. From that point to the boiling temperature we have the best result; and it is therefore important that the condensed water should go into the purifying-cistern at as high a temperature as can be obtained with a thorough air condensation, so that the escaping air shall only carry its load of moisture. In first operating, no tempering water is admitted until the flues become heated. Great economy in working results from applying escape steam from the engines to heating the water in the tempering cistern by means of coils or surface condensers. In this way a much larger quantity of water is atomized with a given amount of fuel, and the heat of the water up to the time it passes into the purifying-cistern is maintained at a high temperature.

To raise and maintain the water in the purifying-cistern to nearly, if not quite, the boiling point, and to furnish air to aid in the incrustation of the lime and other foreign substances on the thorn-brush and straw, and at the same time to carry on, by evaporation, the graduation to a higher degree of density, previous to the final evaporation in the ordinary salt-pans, I pass the tube *n* through the center of the pipe S. This tube is hung in journals so as to be free to rotate. At right angles to this tube I extend from its lower end two or more tubes or arms, *o o*, with small holes, as shown at *p p*. Through this tube I force a constant stream of highly-heated air, which, as it escapes at the openings *p p*, causes the arms *o o* to rotate, and thus the heated air is delivered under the rack-floor on which the thorn-brush and straw rest, and the air bubbles up or rises to the top of the cistern where it escapes. It causes a much larger portion of the lime and other foreign substances to concrete on or encrust the brush than would be the case without the use of the heated air. At the same time the escaping air becomes charged with moisture and carries off a large portion of the water; in fact, by this means the water may be brought as near the point of saturation as it can be without a crystallization of the salt in the purifying-cistern.

When the flues G G′ and nozzle J are properly proportioned so that the escaping brush just fills the flue, and when the horizontal and vertical flues are of sufficient length and height, and heated to nearly the boiling temperature, a single discharge under a pressure of one hundred pounds would, if no tempering water be admitted, increase the density from 10° Baumé to saturation, so that the walls of the flues would be incrusted with salt; but it is

not desirable to carry the graduation above 18 or 20° Baumé, as it is essential that the water be passed through the settling and purifying cistern, and therein freed from gypsum and earthy matters previous to final evaporation. The salt-water pumped from the wells, being first used in the high-pressure boilers, its density is thereby increased in proportion to the amount of steam taken from these boilers for pumping the water from the well, for forcing a supply into the boilers for barrel-making, and all other uses that steam-power can be applied to about a salt-works. The escape steam being moreover used to heat the water in the tempering-cistern, into which it is pumped from the wells, and from which the boilers are supplied, results in an economy of fuel much greater than by any other system that I know of.

I will now describe a modification of the arrangement of flues and jets or escapes, in which the same object may be obtained in a more thorough manner. Fig. 5 is an elevation, part in section, of a tower or shaft with two or more horizontal flues terminating in its base. On top of the tower, which may be built of staves and banded, is the fan Y, precisely similar to the fans used for ventilating mines. The escape-nozzles J J are so placed that the jets are blown toward the open ends H H. The fan Y has to be driven with a velocity equal to drawing currents of air into the flues at the ends H H, which will meet the escaping jet of atomized water with sufficient force to prevent any escape at the open ends. The water thus concentrated and condensed will flow from the opening I.

Fig. 6 shows an arrangement dispensing with the tower. In this the flue G descends from H to I sufficiently to conduct all the water that is condensed in this portion toward I and G′, rises from I to Y′ on a steeper grade, so that the water in that portion will gravitate to I against an upward current of air made by a ventilating-fan placed at Y′.

It will here be proper to state, that I have, by preference, adopted the general construction and details of arrangement hereinbefore described, and that by combining all the features of my invention in the successive stages of the improved process, the best working result will be attained; but it is evident that practical economy may be practiced, and a fair working result obtained, if one or more of the several parts of my invention should be dispensed with. Should the steam-engine, for example, be left out, where other motive power is at hand, it clearly follows that the graduation of the salt-water in the boilers will be diminished in proportion to the lesser quantity of steam used, and that the heating of the tempering water by means of the exhaust steam and surface condensers is lost, while in all other respects the economy and advantages of my improved process would be maintained. And it is equally feasible to dispense entirely with the tempering water, the practical results of the working of my improved mode of evaporation being always lessened in proportion to the degree of graduation abandoned with that portion of the apparatus which is set aside. And, further, all the economy of that part of my invention relating to the evaporation in the boilers and spray-tunnels may be abandoned, and the operation confined to the application of the improved purifying-cistern only, and this improved arrangement of cistern may either be combined with, or worked without, the air-pipe for the admission of hot air.

Having thus described the nature and object of my invention, I do not broadly claim as new the evaporation of the salt-brine under pressure by the escape of steam; but I claim—

1. In combination with the boilers A, the steam-engine, surface condenser, spray-nozzle J and J′, tempering supply-nozzle L, tunnel G and G′, and purifying-cistern N, all arranged and operating substantially in the manner and for the purpose specified.

2. In combination with the boilers A, the spray-nozzle J and J′, tempering supply-nozzle L, tunnel G and G′, and purifying-cistern N, all arranged and operating substantially in the manner and for the purpose specified.

3. In combination with the boilers A, the spray-nozzle J and J′, tunnel G and G′, and purifying-cistern N, all arranged and operating substantially in the manner and for the purpose specified.

4. The cistern N, water-pipe S, air-pipe *n o o*, and rack-floor R, all combined and operating substantially in the manner, and for the purpose specified.

5. The cistern N, water-pipe S, and rack-floor R, all combined and operating substantially in the manner and for the purpose specified.

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Witnesses:

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